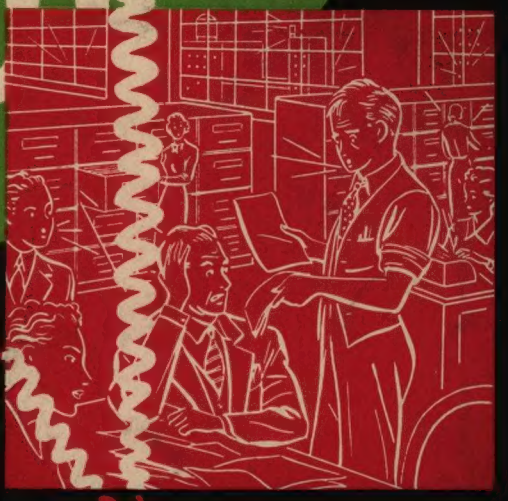
39

LESS NOISE



Where People Work . . .

FEAR

Fear springs from many causes. A woman's shriek and a mouse's squeak can give each other a good scare, when their meeting is unexpected. Any sudden noise frightens—causes a fear reaction. This book tells you how to overcome the strain of fear reactions caused by noise.

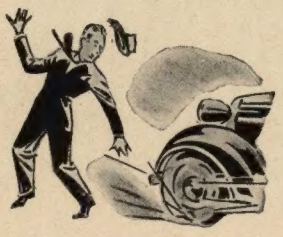
As Long as Noise is Tolerated It Acts as an Irritant from Which There is no Escape

Noise Is an Irritant

Noise interferes with human welfare because it causes a fear reaction. The bodily response is more marked than the simple mental feeling of fear. Everyone has felt the bodily changes of the fear reaction, as in the tensed muscles when making one's first speech in public, or in the cold perspiration after a close shave in an automobile, or the "gone" feeling in the pit of one's stomach at the unexpected noise of a slamming door or tire blowout.

The noise in our working and living environment does not have to be of deafening proportions to start a long-continued fear reaction that is undesirable for the welfare, health and happiness of mankind.

Thus, when noise works beside you, not only does your work suffer, but the mental strain under which you work causes physical uneasiness and results in accelerated fatigue.

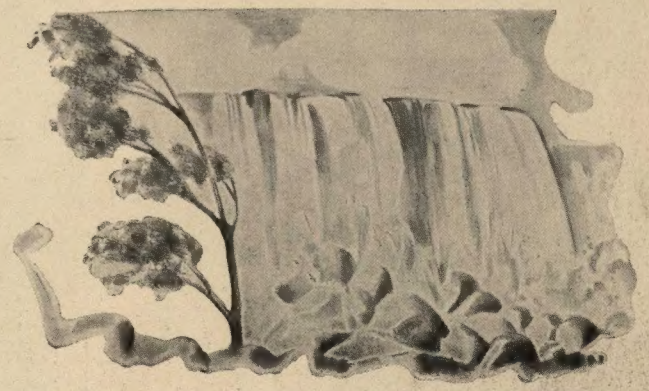


Its Effects Are Automatic and Inescapable

We cannot control our biological reactions to noise. We may not be aware of its effects upon us but they are automatic, of a reflex nature and are more than likely ineradicable.

These effects are not imaginary nor found in only a few nervous people. They have been developed through long centuries of evolution and originally served a useful purpose in warning our remote ancestors to get away from the danger signaled by the roar of a wild animal or the onrush of a landslide.

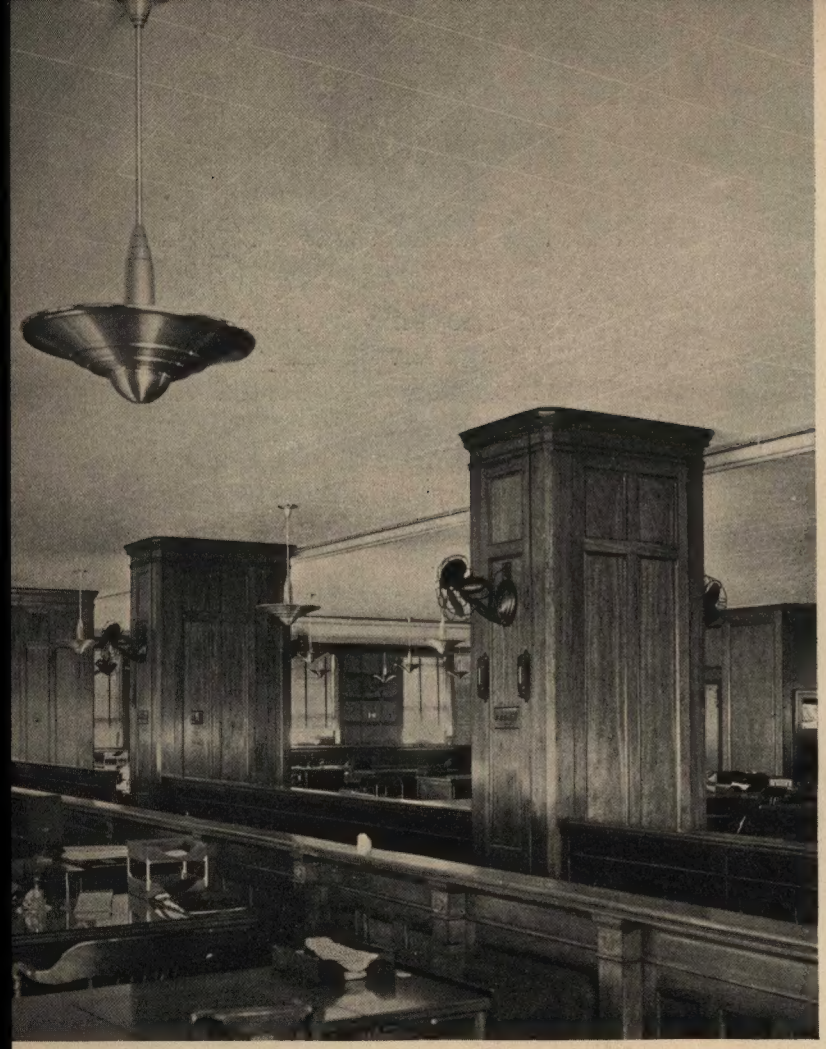
Although useful at one time in mankind's early development, these involuntary and inevitable reactions to noise are now a definite handicap to human welfare in our age of machinery. Whether waking or sleeping, the right sort of noise produces a fear reaction which appears to increase the tenseness of every body muscle.

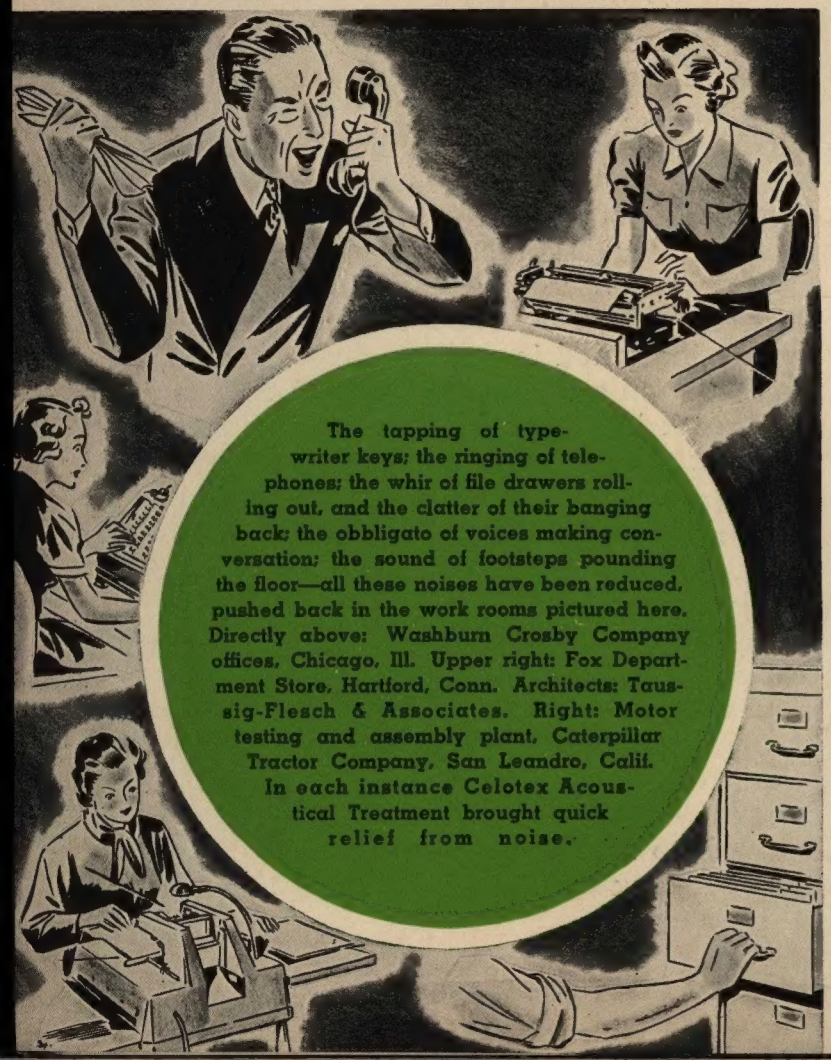


Noise, like water constantly falling on stone—wears away resistance.

Not as much noise is needed to produce these effects as most persons imagine. Experimental work indicates that any noise which is louder than people make when they talk, precipitates an involuntary fear reaction of the entire body. In our evolution noises louder than those of common conversation were usually signals of impending danger, and we now have it apparently indelibly ingrained in our nervous systems to respond with a fear reaction when our ears are struck by noises louder than we make with our own voices in conversation.

When you are next in a place where you have to raise your voice slightly, or where you have to listen closely in order to hear another person, notice how your arms, back, neck—every muscle of your body—is slightly tensed. Notice, too, the heavy feeling in your abdomen after you have been in this place where the noise is loud enough to slightly drown the human voice.

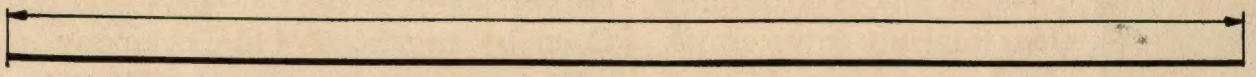




The tapping of typewriter keys; the ringing of telephones; the whir of file drawers rolling out, and the clatter of their banging back; the obbligato of voices making conversation; the sound of footsteps pounding the floor—all these noises have been reduced, pushed back in the work rooms pictured here. Directly above: Washburn Crosby Company offices, Chicago, Ill. Upper right: Fox Department Store, Hartford, Conn. Architects: Taussig-Flesch & Associates. Right: Motor testing and assembly plant, Caterpillar Tractor Company, San Leandro, Calif. In each instance Celotex Acoustical Treatment brought quick relief from noise.

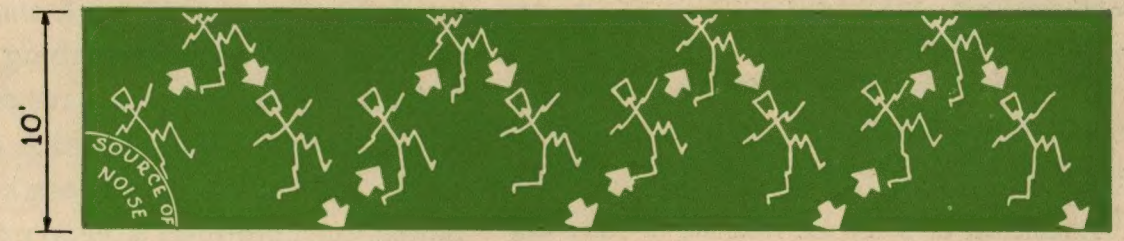
How Acoustical Treatment Quiets Noise

Sound Travels 1120′ in One Second



Plaster and other common materials used for interior finish have a sound absorbing value less than 5%.

Close-up of sound symbol



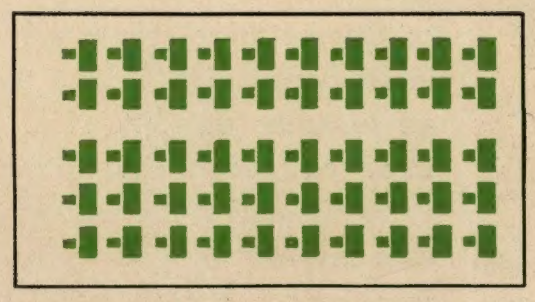
Plaster Ceiling

The diagram above illustrates how sound originating in a room with an ordinary plaster ceiling is constantly reflected from one non-absorbent surface to another, thus filling the room with noise.

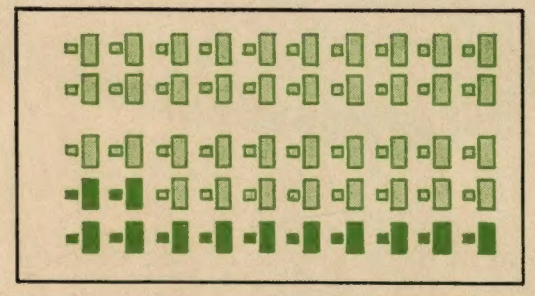
Plaster Ceiling Covered with Acoustical Treatment

In this diagram, sound originating at the same source is reflected to the acoustically treated ceiling, where it is quickly subdued by sound-absorbing properties of the material, in this manner confining the spread of sound and quickly quieting the room. In auditoriums, the air is cleared for succeeding syllables and words.

Below is a simple illustration of the quieting effect of Celotex Acoustical Treatment used in an office occupied by fifty people.



Before acoustically treated



After acoustical treatment

The noise intensity reduction effected by the installation of Celotex Acoustical Treatment upon the ceiling of this office in effect eliminates the noise produced by the workers shown in gray.

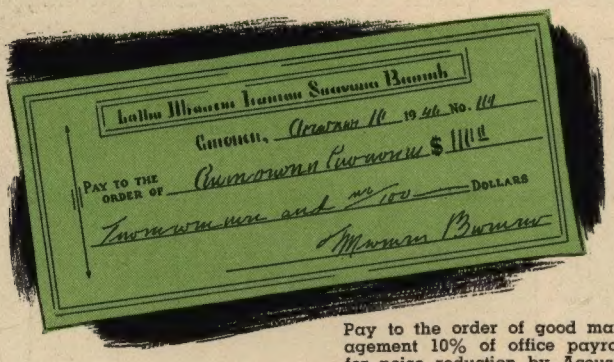
What Quiet Does to Help You Work Well

Quiet in offices promotes clear thinking; saves errors, absences and loss of time. These benefits have been observed by users of Acousti-Celotex in noisy offices:

1. Increased volume of work.
2. Reduction in percentage of errors.
3. Less absences from work.
4. More efficient and economical use of the telephone and other mechanical equipment.
5. Elimination of partitions, resulting in fuller use of floor space and improved illumination and ventilation.
6. An improved atmosphere welcome to customers.
7. A pleasanter, happier disposition in the office force.

The difference between noisy and reasonably quiet conditions may be expressed in terms of about 10% of the total output. Ten per cent of annual salaries represented in the average noisy office makes acoustical treatment, for anything but short-term occupancy, a profitable investment.

Here's Proof that Quiet Pays



Pay to the order of good management 10% of office payroll for noise reduction by Acousti-Celotex, perforated fibre tile.

Although daily experiences confirm these benefits, a quantitative analysis is rarely possible because of the absence of adequate control. The following excerpts are taken from a published report of the experience of the Aetna Life Insurance Company, Hartford, Conn. by an official of that company.

"Before moving into a new building we made a careful and complete study of the effect of noise on employees in order to determine to what extent we should treat the building with sound-absorbing material.

"The department where we made the main test is known as the control department, where 30% of the employees had been on a bonus for more than a year prior to treating the ceiling. In addition to the advantage of having had a bonus in operation, there were several classes of workers in this same room, such as typists, clerical checkers, machine operators, and so on. Our tests, therefore, show the effect on different types of jobs.

"Records of efficiency based on the bonus record were kept for a year in the control department before applying the sound-proofing and then for a year after sound-proofing was applied. The second year showed an increase in efficiency of 9.2%.

"In addition to this complete test, we also made tests in two other rooms which had been working under similar conditions. These tests were not quite as carefully carried on, but were for the purpose of verifying the results of the first test.

"One of these rooms showed an increase in efficiency of 9.4% and the other showed an increase of 7.7%. The average of the three tests shows 8.8% increase.

"At the end of the second year, the ceiling was covered with plaster board and records were kept for that year.

"Every period during this time the sound treatment was effective showed increased output, and immediately following the elimi-

nation of the effectiveness of sound absorption (by covering with plaster board), there was a drop in output.

"During the entire test period of two years four months, we kept a very careful record of errors as well as efficiency and the result shows as follows:

	Reduction in errors after treatment for sound absorption	Increase after covering sound absorption with plaster board
Typists	29%	12%
Machine Operators	52%	37%

"We found also that our employment department records showed that while the acoustical treatment was effective, compared with a corresponding period before treatment, there was a reduction of 47% in employee turnover and 37½% in days lost in the departments where the experiment was carried on. During the same period, the records covering all our home office employees located in Hartford, Conn. showed a reduction of 20% in turnover and 22% in days lost.

"The matter of reduced salary cost could be answered in the following manner: Increased efficiency of 8.8% if taken advantage of on an average salary of $1,000, would be a saving of $88 per year. The cost of sound absorption at a price of 60¢ per square foot,* considering about 50 square feet to each person, would be $30, saving $58 the first year per employee. In addition, consideration should be given to the saving by less errors, turnover, days lost.

"We decided that in our new building we would treat all of the ceilings with the exception of certain storage basement rooms, feeling that while many of our departments do not have a constant noise which might be considered fatiguing, they do have the unusual noises, such as people talking and street noises, and without question, the benefit through comfort and reduced errors will well pay for the cost of the installation"—and these are benefits indeed.

The cost is now substantially lower

How Noise is Measured

The ear accommodates a tremendous range of sound intensities which for convenience are expressed logarithmically in Decibels, and it is common engineering practice to state the noise quieting effect of acoustical treatment of rooms in terms of decibel reduction. Comparative decibel readings — with their corresponding intensity levels—of familiar noises are shown in this simple scale:

Intensity— amount of energy in the sound	*Decibels*	*Type of Noise*
1,000,000,000,000	120	
100,000,000,000	110	Airplane Engine
10,000,000,000	100	
1,000,000,000	90	Heavy Traffic, Pneumatic Drill
100,000,000	80	
10,000,000	70	Noisy Office, Telephone
1,000,000	60	Conversation, Ordinary Traffic
100,000	50	Average Office
10,000	40	Ordinary Conversation
1,000	30	Quiet Home, Quiet Con-
100	20	versation
10	10	Rustle of Leaves, Whisper
1	0	

The calculated increase in loudness of 1 db (decibel) corresponds to an *intensity* increase of 26% and a decrease of 1 db to an *intensity* decrease of 21%. Similarly, a 6 db decrease in loudness corresponds to an *intensity* decrease of 75%.

As the eye is possessed of compensating protective mechanism—the adjustment of the retina to varying light intensities — so, too, does the ear have a power of adjustment in that it does not respond in direct relation to sound intensity variations. For example, a reduction of 6 db (or 75%) in the intensity of office noise by acoustical treatment is judged by the average office worker as a noise reduction of about one-half.

While the eye adjusts itself to see in poor light conditions, we know reading in bad light causes eye strain and eventual impairment of vision. We also know that while the ear does *not* register actual *noise intensities* the nervous system *does* with resulting harm to it: consequently, the harmful effects of noise.

The decibel reduction for any proposed installation can be calculated in advance and the analysis will be significant to a competent acoustical engineer.

Noise can be analyzed to determine its frequency components, which ordinarily are spread over the entire audible frequency range. Frequency, of course, determines pitch — high frequency sounds are high pitched and low booming sounds are of low frequency. Specific noises, such as made by a telephone bell or a ventilating fan, may be characterized by predominant high or low frequencies but usually there are also present a variety of noises having no characteristic frequency, such as traffic noise, for example.

Figure A shows the approximate frequency distribution of two common sources of office noise.

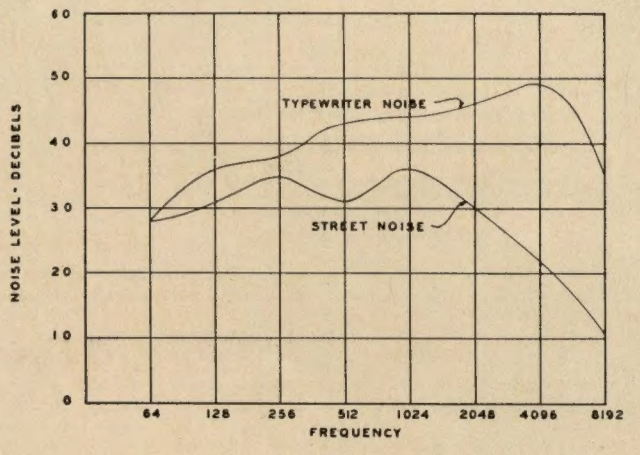


Fig. A

Absorption Coefficients and Specifications of Test Samples

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Types of Mounting

1. Cemented to plaster board. Considered equivalent to cementing to plaster or concrete ceiling.
2. Nailed to 1" x 2" wood furring 12" o.c. unless otherwise indicated.
3. Attached to metal supports applied to 1" x 2" wood furring.
4. Laid directly on laboratory floor.
5. Nailed to 1" x 3" wood furring 18" o.c. and filled in between furring with 1" mineral wool, .33 lbs./sq. ft.
6. Nailed to 2" x 4" wood furring 24" o.c.

Types of Mounting

7. Nailed to 2" x 4" studs, 18" o.c., and filled between studs with 3½" thick mineral wool, 1.14 lbs./sq. ft.
8. Laid on 24 ga. sheet iron, nailed to 1" x 2" wood furring 24" o.c.
9. Attached to special metal supports mounted on 2" x 2" wood furring.
10. Mounted on special metal supports. 2" Rock wool blanket 2.36 lbs./sq. ft. behind unit.
11. 1" Absorbex Type A spot-cemented to 1" Absorbex Type F.
12. 1" Absorbex Type A spot-cemented to 3" Absorbex Type F.

Material	†Thickness	Mounting (Described Above)	Coefficients 128	256	512	1024	2048	4000	*Noise Reduction Coefficient	Unit Size Tested	Wt. (lbs.) Sq. Ft.	Surface	Test No.
Acousti-Celotex, Type C1	1/2"	1	.24	.27	.48	.57	.59		.50	12" x 12"	.84	Painted by mfgr. with oil-base paint. Perforated 441 holes per sq. ft. 3/16" diam., 3/8" deep.	134
Acousti-Celotex, Type C1	1/2"	2	.36	.58	.51	.52	.62		.55	12" x 12"	.84	Same as above.	151
Acousti-Celotex, Type C2	5/8"	1	.19	.20	.69	.85	.65		.60	12" x 12"	.97	Painted same as above. Perforated same as above. 1/2" deep.	136
Acousti-Celotex, Type C2	5/8"	2	.40	.59	.68	.81	.66		.70	12" x 12"	.97	Same as above.	152
Acousti-Celotex, Type C3	13/16"	1	.25	.27	.76	.88	.60		.65	12" x 12"	1.03	Painted same as above. Perforated same as above. 11/16" deep.	137
Acousti-Celotex, Type C3	13/16"	2	.22	.50	.76	.84	.66	.40	.70	12" x 12"	1.03	Same as above.	321
Acousti-Celotex, Type C3	13/16"	9	.22	.56	.76	.87	.60	.25	.70	12" x 24"	1.11	Same as above.	40-43
Acousti-Celotex, Type C4	1-1/4"	1	.37	.43	.98	.79	.57		.70	12" x 12"	1.50	Painted same as above. Perforated same as above. 1-1/16" deep.	138
Acousti-Celotex, Type C4	1-1/4"	2	.35	.60	.98	.80	.54	.49	.75	12" x 12"	1.54	Same as above.	239
Acousti-Celotex, Type C5	13/16"	1	.14	.35	.63	.83	.90		.70	12" x 12"	.95	Unpainted. Perforated 441 holes per sq. ft. 1/4" diam., 5/8" deep.	3
Acousti-Celotex, Type C6	1-1/4"	1	.19	.41	.91	.92	.92		.80	12" x 12"	1.37	Unpainted. Perforated same as above. 1" deep.	4
Acousti-Celotex, Type C7	1"	9	.37	.50	.69	.84	.77	.83	.70	12" x 24"	1.47	Painted by mfgr. with oil-base paint. Perforated 441 holes per sq. ft. 3/16" diam., 7/8" deep.	271
Acousti-Celotex, Type M1	5/8"	1	.17	.29	.58	.82	.82		.65	12" x 12"	1.43	Unpainted. Perforated 676 holes per sq. ft. 5/32" diam., 1/2" deep.	64
Acousti-Celotex, Type M1	5/8"	1	.14	.24	.58	.93	.83		.65	12" x 12"	1.53	Painted with oil-base paint. Perforated same as above.	73
Acousti-Celotex, Type M1	5/8"	2	.17	.43	.53	.79	.88	.63	.65	12" x 12"	1.54	Same as above.	320
Acousti-Celotex, Type M2	1"	1	.15	.34	.88	.95	.77		.75	12" x 12"	2.12	Painted same as above. Perforated same as above. 7/8" deep.	200
Acousti-Celotex, Type M2	1"	9	.22	.53	.69	.99	.74	.63	.75	12" x 24"	2.5	Painted by mfgr. with oil-base paint. Perforated 676 holes per sq. ft. 5/32" diam., 7/8" deep.	40-44
Calicel, Standard	3/4"	1	.16	.19	.57	.95	.71	.68	.60	12" x 12"	2.06	Unpainted.	212
Calicel, Standard	3/4"	1	.15	.22	.58	.96	.76	.80	.65	12" x 12"	2.12	Painted by mfgr. with oil-base paint.	215
Calicel, Standard	1"	1	.20	.29	.76	.97	.79	.69	.70	12" x 12"	2.75	Unpainted.	213
Calicel, Standard	1"	1	.20	.27	.76	.99	.81	.72	.70	12" x 12"	2.56	Painted by mfgr. with oil-base paint.	216
Calicel, Standard	1"	10	.59	.69	.99	.91	.81	.88	.85	12" x 12"	Unit 2.87	Unpainted.	241
Calicel, Tapestry	3/4"	1	.13	.20	.64	.89	.65	.50	.60	12" x 12"	1.96	Unpainted.	217
Calicel, Tapestry	1"	1	.18	.32	.83	.82	.67	.62	.65	12" x 12"	2.84	Unpainted.	218
Calistone	1"	4	.16	.28	.60	.89	.66	.58	.60	12" x 12"	4.61	Unpainted.	220
Calistone	2"	4	.36	.58	.77	.69	.63	.50	.65	12" x 12"	9.82	Unpainted.	221
Absorbex, Type A	1"	1	.18	.26	.63	.96	.77		.65	18" x 18"	2.63	Painted by mfgr. with oil-base paint.	207
Absorbex, Type A	1"	2 (18" o.c.)	.20	.35	.86	.90	.72		.70	18" x 18"	2.63	Same as above.	206
Absorbex, Type A	1"	11	.32	.50	.95	.96	.80		.80	18" x 18"	4.60	Same as above.	11
Absorbex, Type A	1"	5	.58	.77	.98	.92	.79		.85	18" x 18"	Unit 2.29	Same as above.	104
Absorbex, Type A	1"	7	.91	.99	.87	.84	.88		.90	18" x 18"	Unit 2.44	Same as above.	162
Absorbex, Type A	1"	12	.54	.96	.90	.95	.85	.93	.90	18" x 48"	8.50	Same as above.	229
Absorbex, Type C	1"	1	.15	.23	.40	.66	.62		.50	20" x 64"	2.01	Same as above.	49
Absorbex, Type C	1"	2 (16" o.c.)	.21	.27	.48	.63	.54		.50	20" x 64"	2.01	Same as above.	48
Absorbex, Type F	1"	2 (16" o.c.)	.11	.17	.49	.68	.63		.50	20" x 64"	2.14	Same as above.	9
Absorbex, Type F	1"	5	.45	.69	.81	.64	.64		.70	20" x 64"	Unit 2.54	Same as above.	110
Absorbex, Type F	2"	1	.21	.44	.85	.70	.72		.70	20" x 64"	4.22	Same as above.	14
Muffletone	1"	1	.18	.32	.73	.90	.83	.85	.70	12" x 12"	2.32	Unpainted.	286
Muffletone	3/4"	1	.17	.29	.63	.75	.74	.80	.60	12" x 12"	1.48	Unpainted.	39-66
Acousteel, pad plus metal facing and pad supports plus furring	1-1/4" 1-5/8" 2-1/2"	3	.26	.65	.99	.99	.81	.50	.85	12" x 24"	Pad .92	Perforated enameled metal, 3/32" diameter perforations, 2054 per sq. ft.	39-41
Q-T Ductliner	1/2"	8	.35	.25	.54	.75	.76	.66	.60	12" x 24"	.96	Unpainted.	289
Q-T Ductliner	1"	8	.43	.37	.69	.78	.78	.70	.65	12" x 24"	1.52	Unpainted.	290

* The noise reduction coefficient is the average of the coefficients at frequencies from 256 to 2048 cycles inclusive, given to the nearest 5%. This average coefficient is recommended for use in comparing materials for noise quieting purposes as in offices, hospitals, banks, corridors, etc.

For auditorium treatment, attention should be directed to the coefficients at 512 cycles and other frequencies as explained elsewhere.

† Unless otherwise noted, the thickness given is the thickness of the sound-absorbing element forming the face of the construction. The thickness of other sound-absorbing elements in the construction, if used, is indicated by the type of mounting.

LIGHT REFLECTION VALUES

All light reflection values on acoustical materials listed by the A.M.A. are obtained from tests conducted at a laboratory chosen by the Association. The tests are made on samples selected by a representative of the testing laboratory as typical of the actual material submitted for sound absorption tests. *Following are results of such tests on Celotex Acoustical Products:*

MATERIAL	THICKNESS	COLOR OF PAINT	LIGHT REFLECTION IN PER CENT
Acousti-Celotex, Type C-3	13/16"	White	81-85
Acousti-Celotex, Type M-2	1"	White	81-85
Muffletone	1"	Natural White-Unpainted	56-60

These products are manufactured in different thicknesses. The light reflection is determined by the surface of the product and is not affected by thickness. For example, Acousti-Celotex, Types C-1, C-2, C-4, and C-7 are obtainable with the same light reflection characteristics as the Type C-3 listed above.

Celotex Acoustical Products

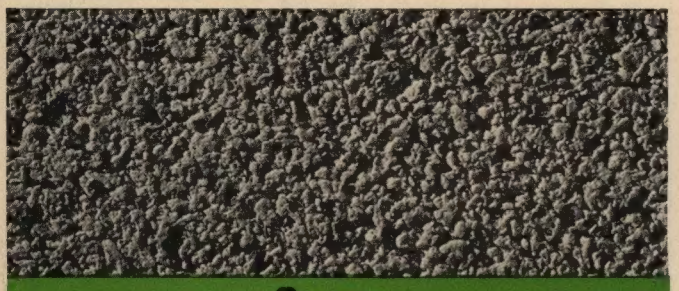
ACOUSTI-CELOTEX

ACOUSTI-CELOTEX is the identifying trademark of a perforated fibre (cane or mineral) acoustical tile, in which the perforations are of *controlled* diameter, depth and spacing. This feature insures uniform performance and practical repaintability without loss of absorption.

MUFFLETONE — Standard

MUFFLETONE — Fissured

MUFFLETONE is the name of our precast, porous gypsum tile, available in a variety of integrally mixed, beautiful pastel colors.



CALICEL

CALISTONE

CALICEL and CALISTONE—sound absorbing artificial stone. In Calicel, the natural beauty of the expanded mineral aggregate is retained by means of a transparent binder; in CALISTONE, the Portland cement binding agent adds unusual moisture-proofness to the same porous mineral aggregate. Especially desirable for wall treatment.

ABSORBEX

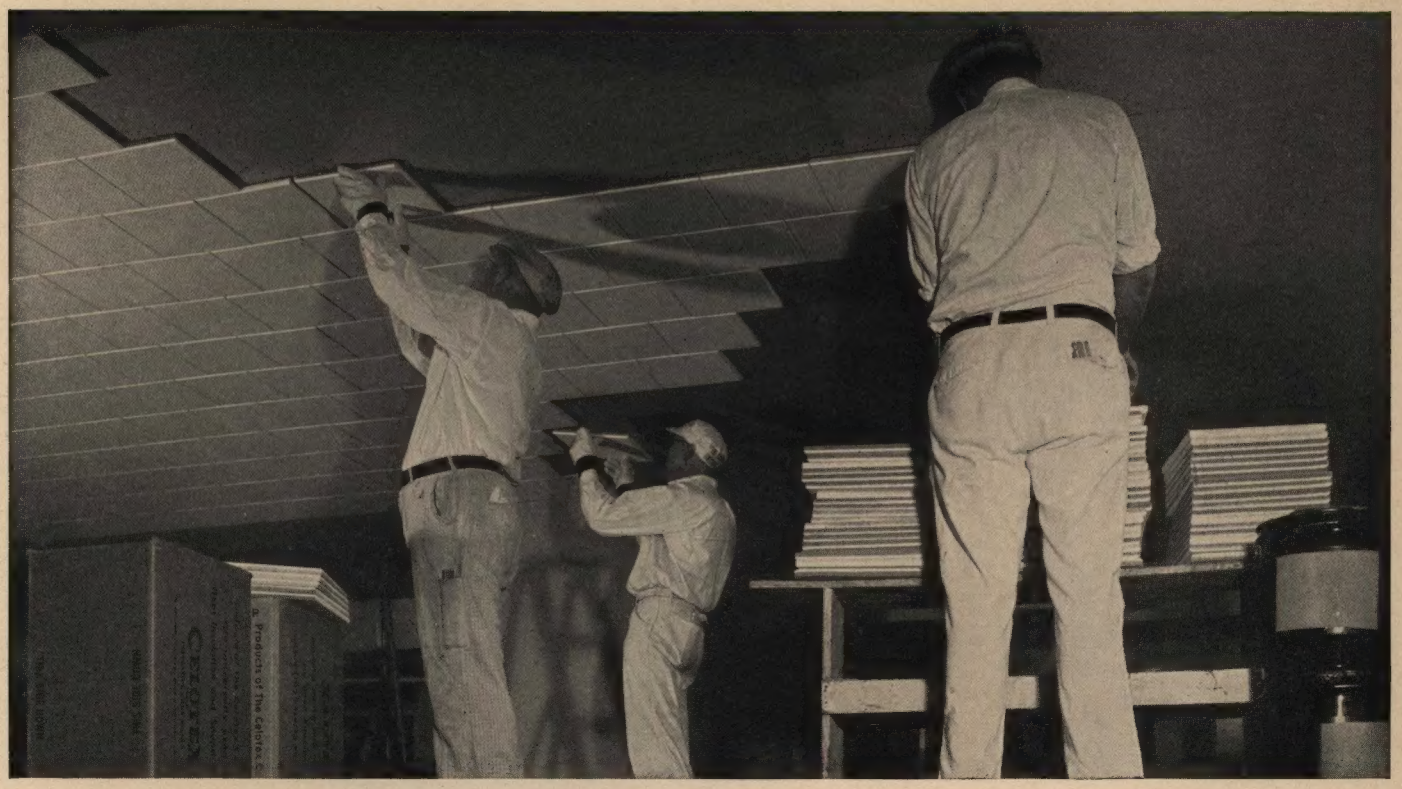
ACOUSTEEL

ABSORBEX is an ingenious sound-absorbing tile made of matted wood fibres, protected and bound together with a fire-resistant binder.

ACOUSTEEL is a paintable, perforated steel tile enclosing a sound-absorbing element of incombustible mineral fibre.

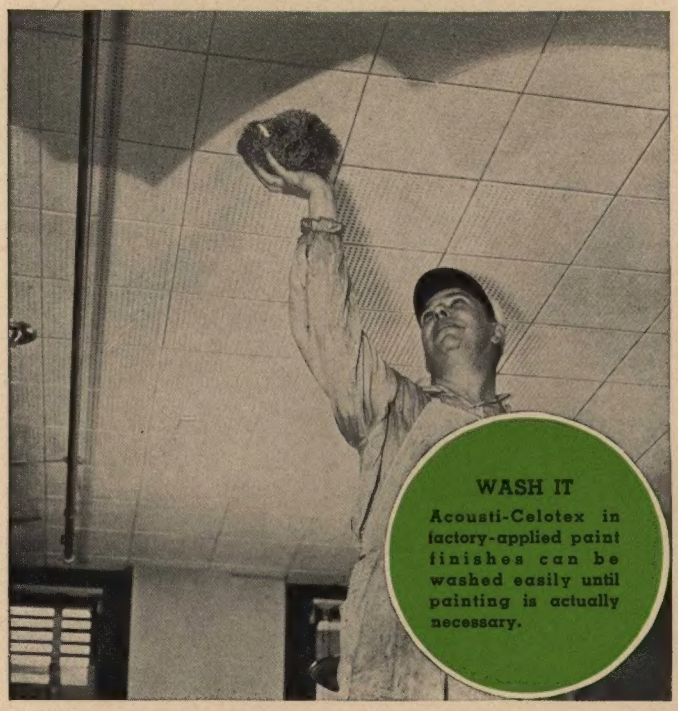
The registered trade marks above identify acoustical materials manufactured and marketed by The Celotex Corporation

From Noise to Quiet is Often Overnight



The process of transforming a noisy room into a quiet one with Celotex Acoustical Products is not an ordeal. In occupied quarters, the work is usually done overnight by skilled, trained mechanics.

Where Light Reflection is Important Be Sure You Can Paint Acoustical Material You Buy



QUIET

through Celotex Acoustical Products is now within the means of every successful business, large or small. Complete information is yours upon request without obligation. Just write or call the distributor shown below.

THE CELOTEX CORPORATION, CHICAGO

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